

Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices.

A49.9
R31A
Cap. 2

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service

ARS 44-142-1
May 1964

ENERGY METABOLISM RESEARCH PROGRESS REPORT

Automatic Computation and Summarization of Carbon, Nitrogen, and Energy
Balance Experiments

W. P. Flatt, C. E. Coppock, and L. A. Moore
Energy Metabolism Laboratory, Animal Husbandry Research Division
and

A. Heath, F. Dickson, and K. A. Tabler
Computer Laboratory, Biometrical Services

The immense amount of time and labor required to conduct and summarize carbon, nitrogen, and energy balance experiments with animals has discouraged many scientists from engaging in this field of research. Blaxter (2)^{1/} summarized the energy metabolism experiments, which have been conducted in the major laboratories of the world. He stressed the fact that results accrue very slowly. For example, each two-period balance experiment conducted in the Copenhagen laboratory required one man-year to complete, according to Hutchinson (8). Wainman and Blaxter (10) aptly referred to this as being truly "a marathon at a snail's pace."

Three major approaches to solving the problems of studying the energy metabolism of large animals have been as follows:

The first alternative was to recompute, re-evaluate, re-express, and re-interpret the energy balance data collected by previous workers in so many ways that the answers sought became more obscure rather than clarified.

The second alternative was to reduce the labor required per experiment by using closed circuit indirect calorimetry and constructing the chambers in such a way that a minimum amount of attention was required to routinely run experiments. The workers in Scotland (1, 10, 11), Australia (7), and East Africa (9) have used this system extensively with sheep and to a limited extent with goats and steers. However, most of the current research with cattle is being conducted using open circuit indirect calorimetry. The technical difficulties associated with the closed circuit system are matched with the increased labor requirements for operating open circuit chambers.

The third alternative, using automatic recording and computing equipment to collect and record respiration trial data in order to reduce labor costs, was described by Flatt and others (6). The system has been used extensively in studies with lactating and nonlactating dairy cows. The formulae used to prepare programs to summarize the respiration data were reported by Flatt and Tabler (5). The number of recent inquiries indicates a widespread interest in this method.

^{1/} Numbers in parentheses refer to references on page 4.

U. S. DEPT. OF AGRICULTURE
NATIONAL AGRICULTURAL LIBRARY

AUG 21 1964

CURRENT SERIAL RECORDS

Regardless of the method used to collect respiration trial data, the routine computations required to evaluate the studies are numerous. The amounts of nutrients consumed, absorbed, metabolized, and excreted by various pathways are variables included in almost every balance trial. The carbon, nitrogen, and energy balance computations for a single trial require a considerable amount of time even after all the raw data have been collected.

The calculation of total heat production from indirect calorimetric measurements is another problem in that slightly different formulae have been used by different authors. A committee (3) was appointed at the first symposium on energy metabolism in 1958, and in 1963 they (4) recommended the constants to be used in calculating heat production. This recommendation, if followed by others, will alleviate one problem, but there will still be no uniformity in the manner of reporting the results. For example, heat production has been reported as kcal/24 hr, kcal/W_{kg}^{.75}, kcal/W_{kg}^{.73}, kcal/M², kcal corrected to a standard day of 12 hours standing, kcal corrected to 24 hours lying, and so forth. Various so-called "corrections" have also been applied to the original data to the extent that direct comparisons are difficult, if not impossible. To compare the results of experiments with those reported by others usually requires transformation of the values into several different forms.

A computer program (No. 246 C) has been prepared for use with an electronic computer, and it has been used routinely to calculate and summarize energy metabolism and digestion trials conducted in the U.S. Department of Agriculture's Energy Metabolism Laboratory at Beltsville, Md. The program was so prepared as to be general enough to use for a wide variety of experiments, with the amounts of feeds ranging from 1 g to 999 kg per experimental period. Therefore, an experiment of 1 day with a mouse can be summarized with the same program used to summarize a month's data with a cow. The respiration trial data may be from a variety of sources, including open-circuit respiration chambers, closed-circuit respiration chambers, tracheal cannula techniques, methods involving the use of masks or helmets, or any other method which provides data on the oxygen consumption, and carbon dioxide and methane production of the animal.

The 246 C program has been used routinely for almost 2 years. The average time required to compute and punch all the data for a balance trial consisting of two 24-hour respiration periods and 5 to 7 days' collection of excreta has been 1.8 minutes. Each trial, summarized on a daily basis, plus the average, results in over 300 answers per respiration period. The intermediary computations are punched to facilitate checking for errors in the original data and locating reasons for discrepancies. At the rate of approximately 600 cards per minute, these cards can be sorted according to animal, trial, experiment, variable, or any desired category. The answers can be printed on plain paper at the rate of 150 cards per minute. The total time required to calculate, punch, and print the results of a complete balance trial is less than 3 minutes.

In order to facilitate comparison of the experimentally determined values with predicted values based on formulae reported in the literature or with other data, which had been reported in a different manner, the program included formulae for transformation into forms that had been used by previous investigators. For some data, the formulae are not appropriate, and these answers may be ignored. For

example, the constants used to calculate the maintenance requirements are not appropriate for use with lactating animals, but the computer time would not be reduced by deletion of this step. This provision makes the program lengthy, but versatile.

Another feature included in the program was the use of lignin and chromium sesquioxide to compute digestion coefficients indirectly. Analyses instead of the proximate constituents may be substituted in those fields, and computations are performed in the usual manner. Lignocellulose, cell-wall constituents, and lignin are routinely determined in the Beltsville laboratory, so they are included in the format. If another reference material, such as silica or anthraquinone violet dye, is preferred in some experiment, it could be substituted in the field for lignin or Cr_2O_3 . It is not necessary to have gas or urine data to use the program for digestibility computations. If urine data are collected, the nitrogen balance may be calculated.

The data, when computed in this manner, are in a form that can be used for statistical analysis. A program for computing means, standard deviations, and coefficients of variation has been modified to make data from the 246 C program compatible without any transformations.

The suitability of the tabular material for publication without any transcribing is demonstrated by the accompanying illustration. Data from a current series of studies with high-producing lactating dairy cows were computed and listed in the manner used routinely. The tables that would be chosen for publication would depend upon the goals of the experiment and the points that would be emphasized by the investigator. The uniformity in the method of presentation of tabular data should be advantageous to the author and reader alike.

The advantages of automatic computations are:

1. Speed of computation (1.8 minutes per trial).
2. Reduction of errors in calculations.
3. Ease of detecting errors which may occur.
4. Uniformity of calculating data.
5. Uniformity of summarizing answers.
6. Ease of sorting answers to facilitate comparisons.
7. Ease of statistical analysis.
8. Tabular material ready for publication or rapid reproduction.

Discussion

Routine calculation and summarization of carbon, nitrogen, and energy balance experiments with animals have been accomplished by preparing a computer program for this purpose. Any laboratory that uses open or closed circuit indirect calorimetry could use this method to save much time and effort. The advantages to this method are the speed, accuracy, and ease of using the data for additional computations, uniformity in calculations, and method of reporting results.

Due to the rapid growth of energy metabolism research in the past few years and the potential increased interest in this area of research, establishment of a central computer laboratory to process data from all the laboratories would be helpful. The use of a standard format, punched cards, and an electronic computer to prepare data for publication in an International Energy Metabolism Research Journal would improve the rapid dissemination of information, increase uniformity of reporting results, and bridge the language barrier which now exists.

If raw data from all the laboratories in the world that are conducting energy metabolism studies were sent periodically to a central computer laboratory, the total computer time required to summarize and list the results would be approximately 8 hours per month. The answers would be returned to the scientist, who could decide whether the material warranted publication as a progress report or a completed piece of research. Periodically, the data from all laboratories could be summarized and reported in standard tables, giving credit to the original investigators who collected the data. In this manner, the usefulness of each experiment would be improved.

Acknowledgments

Energy metabolism research with large animals requires the cooperative efforts of many persons, regardless of the methods used. The authors gratefully acknowledge the technical assistance of Mrs. B. D. Owens, Messrs. K. A. Barnes, O. Bowman, F. Sweeney, L. D. England, and W. C. Marcus. They conducted the digestion and respiration trials, cared for the animals, collected and prepared samples for analysis, conducted the chemical analyses, and prepared the data for computations with the electronic computers. The cooperation and efficiency of the Computer Laboratory staff in regularly processing the data is also gratefully acknowledged. Experimental animals and feeds used in several of the experiments were obtained through the cooperation of Dr. R. W. Hemken, Dairy Science Department, University of Maryland, College Park, Md.

References

1. Blaxter, K. L. The Energy Metabolism of Ruminants. Charles C. Thomas, Springfield, Ill. 1962.
2. _____ The Nutritive Value of Feeds as Sources of Energy: A Review. J. Dairy Sci. 39: 1396-1424. 1956.
3. Brouwer, E. Report of the Committee on Constants. Proc. Second Symposium on Energy Metabolism of Farm Animals. Wageningen, Netherlands. E.A.A.P. Pub. No. 10: 319-322. 1961.

4. Brouwer, E. Report of the Committee on Constants. Personal communication. 1963.
5. Flatt, W. P., and Tabler, K. A. Formulae for Computation of Open Circuit Indirect Calorimeter Data with Electronic Data Processing Equipment. Proc. Second Symposium on Energy Metabolism of Farm Animals. Wageningen, Netherlands. E.A.A.P. Pub. No. 10: 39-48. 1961.
6. _____, Van Soest, P. J., Sykes, J. F., and Moore, L. A. A Description of the Energy Metabolism Laboratory at the U.S. Department of Agriculture, Agricultural Research Center in Beltsville, Maryland. Proc. I. Symposium on Energy Metabolism. Copenhagen, Denmark. E.A.A.P. Pub. No. 8: 53-64. 1958.
7. Graham, N. McC. Measurement of the Heat Production of Sheep. The Influence of Training and of a Tranquilizing Drug. Proc. Australian Soc. Animal Prod. 4: 138-144. 1962.
8. Hutchinson, J. C. D. Further Comments on Net Energy Measurements. Proc. Nutr. Soc. 14: 140-142. 1955.
9. Rogerson, A. The Effect of Environmental Temperature on the Energy Metabolism of Cattle. J. Agr. Sci. 55: 359-364. 1960.
10. Wainman, F. W., and Blaxter, K. L. Closed-circuit Respiration Apparatus for the Cow and Steer. Proc. I. Symposium on Energy Metabolism. Copenhagen, Denmark. E.A.A.P. Pub. No. 8: 80-84. 1958.
11. _____ and Blaxter, K. L. Development in the Design of Closed-circuit Respiration Apparatus for Animals Weighing up to 70 kg. Proc. I. Symposium on Energy Metabolism. Copenhagen, Denmark. E.A.A.P. Pub. No. 8: 85-92. 1958.

Note: Illustrative material appears on pages 6 to 16, inclusive.

A PROPOSED METHOD OF PUBLICATION OF ENERGY METABOLISM RESEARCH DATA,
BASED ON THE USE OF AN ELECTRONIC COMPUTER AND A STANDARD FORMAT

W.P. FLATT AND A. HEATH

AGRICULTURAL RESEARCH SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE
BELTSVILLE, MARYLAND, U.S.A.

DURING THE PAST CENTURY MANY VOLUMES HAVE BEEN WRITTEN ABOUT THE ENERGY METABOLISM OF LARGE ANIMALS. THESE REPORTS HAVE APPEARED IN MANY DIFFERENT FORMS, RANGING FROM EXPERIMENT STATION REPORTS AND TECHNICAL PAPERS IN SCIENTIFIC JOURNALS TO TEXTBOOKS AND REFERENCE BOOKS. IN ADDITION TO THE PUBLICATIONS IN WHICH ORIGINAL DATA WERE PRESENTED, A CONSIDERABLE NUMBER OF PAPERS WERE WRITTEN INTERPRETING, EVALUATING, RE-EVALUATING AND PHILOSOPHIZING ABOUT THE SUBJECT. SOME OF THESE ARTICLES WERE WRITTEN ALMOST 50 YEARS AFTER THE EXPERIMENTS WERE CONDUCTED, BY PERSONS WHO HAD NOTHING TO DO WITH THE ORIGINAL STUDIES. SOME WORKERS HAVE DEVOTED THEIR CAREERS TO RE-CALCULATING THE RESULTS OF OTHERS, WITHOUT EVER HAVING CONDUCTED A BALANCE TRIAL THEMSELVES.

THE EXTENSIVE USE, AND IN SOME CASES ABUSE, OF THE DATA COLLECTED BY KELLNER, ARMSBY, MOLLGAARD, AND OTHER EARLY WORKERS IN THE FIELD IS A TRIBUTE NOT ONLY TO THE SCIENTIFIC MERIT OF THEIR RESEARCH, BUT IS ALSO A MONUMENT TO THE THOROUGHNESS WITH WHICH THEY REPORTED THE RESULTS OF THEIR EXPERIMENTS. WHEN EACH BALANCE EXPERIMENT, CONSISTING OF TWO COLLECTION TRIALS AT DIFFERENT PLANES OF NUTRITION, REQUIRED ONE MAN-YEAR TO COMPLETE, AS WAS THE CASE IN MOLLGAARD'S LABORATORY, IT IS NOT TOO SURPRISING THAT EVERY POSSIBLE USE WOULD BE MADE OF THE DATA. EVEN WITH THE ADVENT OF NEWER METHODS WHICH HAVE REDUCED THE LABOR REQUIRED TO COLLECT THE DATA, ENERGY METABOLISM RESEARCH IS STILL TOO COSTLY FOR MOST INSTITUTIONS TO AFFORD. SINCE SO MANY DETAILED OBSERVATIONS AND PRECISE CHEMICAL ANALYSES ARE REQUIRED FOR EACH BALANCE TRIAL, MUCH VALUABLE NUTRITIONAL AND PHYSIOLOGICAL INFORMATION IS AVAILABLE AS A RESULT OF THESE STUDIES. UNFORTUNATELY, MANY OF THE EXPERIMENTS ARE NEVER REPORTED IN SUFFICIENT DETAIL TO MAKE FULL USE OF THE DATA. THE LACK OF UNIFORMITY IN THE METHODS OF COMPUTATION AND PRESENTATION OF THE RESULTS ALSO PRESENT DIFFICULTIES. EVEN THE CONSTANTS USED IN COMMON COMPUTATIONS DIFFER FROM ONE LABORATORY TO THE NEXT, AND THE VALIDITY OF THE APPLICATION OF VARIOUS 'CORRECTIONS' HAS NOT BEEN ESTABLISHED NOR AGREED UPON BY THE CURRENT WORKERS IN THE FIELD.

ONE REASON FOR THE FAILURE OF SOME WORKERS TO REPORT DETAILED INFORMATION ABOUT EACH EXPERIMENT IS THAT ONLY SUMMARIZED RESULTS FROM MANY TRIALS ARE PUBLISHED, IN COMPLIANCE WITH THE EDITORIAL POLICIES OF THE SCIENTIFIC JOURNALS. THE ORIGINAL DATA FROM EXTENSIVE TRIALS WOULD BE OF INTEREST TO MANY PERSONS OTHER THAN THOSE ENGAGED IN ENERGY METABOLISM RESEARCH. PHYSIOLOGISTS, NUTRITIONISTS, AGRICULTURAL CHEMISTS, AND PERSONS COMPILING FEED COMPOSITION TABLES, ANIMAL REQUIREMENT TABLES AND FEEDING STANDARDS WOULD EACH USE THE DATA IN A LITTLE DIFFERENT MANNER, WITH EACH PLACING EMPHASIS ON A DIFFERENT ASPECT OF THE EXPERIMENTS.

DURING THE PAST TEN YEARS, THERE HAS BEEN A WIDESPREAD INTEREST IN ESTABLISHING FACILITIES TO STUDY THE ENERGY METABOLISM OF LARGE ANIMALS. RESPIRATION CHAMBERS HAVE BEEN BUILT IN GERMANY, NETHERLANDS, SCOTLAND, AUSTRALIA, JAPAN, EAST AFRICA, SWITZERLAND, DENMARK, FRANCE, AND THE U.S.A. A NUMBER OF NEW LABORATORIES ARE BEING PLANNED IN THE UNITED STATES, AND SOON THERE WILL BE CHAMBERS BUILT IN NORWAY, AND PERHAPS SWEDEN. FROM THE PRESENT TREND, IT APPEARS THAT WITHIN THE NEXT FIVE YEARS THERE WILL BE OVER 25 LABORATORIES IN 15 COUNTRIES USING APPROXIMATELY 65 RESPIRATION CHAMBERS OR DIRECT CALORIMETERS TO STUDY THE ENERGY METABOLISM OF CATTLE, SHEEP AND GOATS. IT IS POTENTIALLY POSSIBLE THAT 3000 ENERGY

BALANCE TRIALS PER YEAR COULD BE CONDUCTED. THE USEFULNESS OF THESE DATA, IF DISSEMINATED IN A UNIFORM MANNER, WOULD BE TREMENDOUS. HOWEVER, THE LANGUAGE BARRIER, INCOMPLETENESS IN DESCRIBING METHODS USED, OVER-SUMMARIZATION, PROCRASTINATION IN PUBLISHING FINAL RESULTS, AND THE PROBLEM OF UTILIZING A MASS OF DATA FROM MANY SOURCES COULD GREATLY REDUCE THE NET GAIN FROM THE COMBINED EFFORTS OF SO MANY LABORATORIES.

THE USE OF ELECTRONIC DATA PROCESSING EQUIPMENT NOT ONLY TO COMPUTE, BUT ALSO TO SUMMARIZE AND TABULATE DATA IN A STANDARD FORM WHICH CAN BE READILY AND INEXPENSIVELY REPRODUCED WOULD SOLVE SOME OF THE PROBLEMS LISTED ABOVE. IF THE INVESTIGATOR SUBMITTED THE EXPERIMENTAL DESIGN, A BRIEF DESCRIPTION OF THE GOALS AND METHODS USED IN THE STUDIES, ALONG WITH THE QUANTITIES AND CHEMICAL COMPOSITION OF THE FEEDS, EXCRETA, GAS, AND PRODUCTS MEASURED, THESE COULD BE PUNCHED INTO CARDS AND PROCESSED IN A ROUTINE MANNER. THE RESULTING ANSWER CARDS, WHEN SORTED AND LISTED ACCORDING TO THE DESIRES OF THE INVESTIGATOR OR EDITORIAL BOARD, COULD SERVE AS THE MANUSCRIPT. SINCE MANY ANSWERS WHICH WOULD BE OBTAINED BY USING A GENERAL PROGRAM, SUCH AS THE ONE DEVELOPED AT BELTSVILLE, WOULD NOT BE APPROPRIATE FOR SOME EXPERIMENTS, THE INVESTIGATOR WHO SUBMITTED THE DATA COULD EDIT THE MATERIAL, DELETING THOSE TABLES WHICH WERE NOT NEEDED, AND ADDING A BRIEF SUMMARY OF THE RESULTS. THE REVISED MANUSCRIPT COULD THEN BE REPRODUCED BY SOME RELATIVELY INEXPENSIVE MANNER, SUCH AS MULTILITH, AND DISSEMINATED TO INTERESTED PERSONS.

THE FEASIBILITY OF SUCH A METHOD IS DEMONSTRATED BY THIS PAPER AND THE ACCOMPANYING TABLES. THIS ENTIRE PAPER WAS PREPARED USING PUNCHED CARDS AND ELECTRONIC DATA PROCESSING EQUIPMENT. THE TEXT WAS PUNCHED INTO CARDS, BUT FOR ROUTINE PUBLICATION, TYPESCRIPTS WOULD BE MORE SUITABLE AND EASY TO PREPARE. THE EXPERIMENTAL METHODS USED, TYPES OF RATIONS AND ANIMALS USED, EXPERIMENTAL CONDITIONS AND OTHER FACTORS COULD BE CODED AND INCLUDED IN A STANDARD FORMAT. SINCE ALL TABULAR MATERIAL RESULTING FROM THE AUTOMATIC COMPUTATIONS IS IN A STANDARD FORMAT, THE TRANSLATION OF THE TABLE HEADINGS INTO GERMAN, FRENCH, AND ANY OTHER LANGUAGE DESIRED WOULD MAKE THEM MULTILINGUAL. THE MORE INFORMATION WHICH COULD BE CODED AND PRESENTED IN TABULAR FORM, THE MORE READILY IT COULD BE UNDERSTOOD BY PERSONS SPEAKING ANOTHER LANGUAGE. STATISTICAL ANALYSIS AND COMPILATION OF SUMMARIES USING DATA FROM ALL LABORATORIES WOULD ALSO BE POSSIBLE IF THIS METHOD OF PRESENTATION WERE ADOPTED.

THE DATA FROM A CURRENT EXPERIMENT WITH A HIGH-PRODUCING LACTATING HOLSTEIN COW CONSUMING ALFALFA HAY AND A CONCENTRATE MIXTURE WERE COMPUTED AND LISTED AS SHOWN IN THE ACCOMPANYING TABLES. ONLY THE AVERAGES FOR EACH TRIAL WERE INCLUDED, SO THAT ALL THE DIFFERENT TYPES OF TABLES RESULTING FROM THE STANDARD 246 C PROGRAM COULD BE PRESENTED. ORDINARILY, TABLES 701, 711, 721, 731, 771, 781, 961, 962, AND 963 WOULD BE DELETED BECAUSE THE FORMULAE WERE NOT APPROPRIATE FOR USE IN THESE TRIALS. THE NUMBERS OF DIGITS BEYOND THE DECIMALS DO NOT IMPLY THAT THE MEASUREMENTS WERE THAT ACCURATE NOR THAT THEY WERE ALL SIGNIFICANT DIGITS. IN ORDER FOR THE FORMAT TO BE STANDARD AND USEFUL FOR A WIDE VARIETY OF EXPERIMENTS, IT WAS NECESSARY TO HAVE TOO MANY DIGITS PUNCHED IN SOME FIELDS. THE INVESTIGATOR AND READER SHOULD BE AWARE OF THIS WHEN INTERPRETING THE RESULTS.

THE COMPUTATION OF ALL THESE TRIALS, ALONG WITH DAILY BALANCE FIGURES FOR 22, 24-HOUR RESPIRATION PERIODS, TOOK LESS THAN 11 MINUTES. THERE WAS NO TYPING OR TRANSFER OF FIGURES INVOLVED, AND THE ONLY EDITING WAS THE SEPARATION OF THE TABLES SO AS NOT TO BE CONTINUED ON THE NEXT PAGE.

PUNCHED CARD LAYOUTS AND DESCRIPTIONS

CARD	COL.	DESCRIPTION (DECIMALS ARE PUNCHED)	DIGIT
1		CARD FORMAT FOR 246 C PROGRAM ANSWERS (CARDS 070-097)	
2		CARD COL. DESCRIPTION (DECIMALS ARE PUNCHED)	
3	01-03	CARD NO.	XXX
4	04-05	TREATMENT CODE NO.	XX
5	06	BLANK	(X)
6	07-10	ANIMAL NO.	XXXX
7	11-12	TRIAL NO.	XX
8	13-14	EXPERIMENT NO.	XX
9	15	DECIMAL	.
10	16	BLANK	(X)
11	17	SUB-CARD NO.	X
12	18-19	CODE NO. OF INPUT DATA USED IN COMPUTATIONS	XX
13	20	RESPIRATION PERIOD NO. OR METHOD OF SAMPLE PRES.	X
14	21-28	FIELD NO. 1 (METABOLISM DATA - 246 C OUTPUT)	XXXX.
15	29-36	FIELD NO. 2 (METABOLISM DATA - 246 C OUTPUT)	XXXX.
16	37-44	FIELD NO. 3 (METABOLISM DATA - 246 C OUTPUT)	XXXX.
17	45-52	FIELD NO. 4 (METABOLISM DATA - 246 C OUTPUT)	XXXX.
18	53-60	FIELD NO. 5 (METABOLISM DATA - 246 C OUTPUT)	XXXX.
19	61-68	FIELD NO. 6 (METABOLISM DATA - 246 C OUTPUT)	XXXX.
20	69-76	FIELD NO. (METABOLISM DATA - 246 C OUTPUT)	XXXX.
21	77-80	COMPUTER CODES (COMPUTATION SEQUENCE)	XXXX

1	TREATMENT CODES		
2	EXPERIMENT 19 INFLUENCE OF RATION AND STAGE OF LACTATION ON ENERGY		
3	COL. 04 (CARDS 70-97)		
4	6	60 PCT ALFALFA + 40 PCT CORN-SOYBEAN OIL MEAL MIX (DM BASIS)	D
5	7	40 PCT ALFALFA + 60 PCT CORN-SOYBEAN OIL MEAL MIX (DM BASIS)	E
6	8	20 PCT ALFALFA + 80 PCT CORN-SOYBEAN OIL MEAL MIX (DM BASIS)	F
7	COL. 05 (CARDS 70-97)		
8	1	FASTING	
9	2	EARLY LACTATION, NON-PREGNANT, AD LIBITUM	
10	3	EARLY LACTATION, NON-PREGNANT, RESTRICTED FEED	
11	4	MID LACTATION, NON-PREGNANT, AD LIBITUM	
12	5	MID LACTATION, NON-PREGNANT, RESTRICTED FEED	
13	6	LATE LACTATION, PREGNANT, AD LIBITUM	
14	7	LATE LACTATION, PREGNANT, RESTRICTED FEED	
15	8	NON-LACTATING, PREGNANT, AD LIBITUM	
16	9	NON-LACTATING, PREGNANT, RESTRICTED FEED	

TABLE 701 MAINTENANCE REQUIREMENTS (DETERMINED) M1=ME-1.61G+,1.43G-

IDENT	TDN	GE	DE	ME1	ME2(RQ)	ME4(CN)	ME3(RQ)
	KG	MCAL	MCAL	MCAL	MCAL	MCAL	MCAL
62 38840119. 1000	4.402	28.522	19.691	16.795	21.382	12.209	21.029
62 38840219. 1000	3.994	26.047	17.815	15.505	17.453	13.558	17.369
63 38840319. 1000	3.064	18.792	13.895	12.081	14.576	9.586	14.355
63 38840419. 1000	4.478	29.669	20.065	16.969	18.060	15.878	17.460
74 38840520. 1000	1.736	10.772	7.620	6.696	10.912	2.480	11.132
74 38840620. 1000	2.453	15.455	10.731	9.370	12.778	5.962	12.588

TABLE 711 MAINTENANCE REQUIREMENTS (DETERMINED) M2=ME-2.00G+,1.67G-

IDENT	TDN	GE	DE	ME5	ME6(RQ)	ME8(CN)	ME7(RQ)
	KG	MCAL	MCAL	MCAL	MCAL	MCAL	MCAL
62 38840119. 1000	3.009	19.497	13.460	11.481	17.178	5.783	16.740
62 38840219. 1000	2.096	13.672	9.351	8.138	10.558	5.719	10.453
63 38840319. 1000	1.300	7.972	5.894	5.125	8.224	2.025	7.950
63 38840419. 1000	3.291	21.803	14.746	12.470	13.825	11.115	13.080
74 38840520. 1000	-1.335	-8.281	-5.858	-5.148	.088	-10.385	.362
74 38840620. 1000	-.293	-1.847	-1.282	-1.120	3.113	-5.353	2.877

TABLE 721 MAINTENANCE/500KG M1/500KG=ME(500/W)P (1.61+,1.43-)

IDENT.	P=1.0	P=.87	P=.75	P=.73	P=.67	P=.56
	MCAL	MCAL	MCAL	MCAL	MCAL	MCAL
62 38840119. 1000	13.091	13.522	13.932	14.002	14.223	14.608
62 38840219. 1000	12.085	12.483	12.862	12.926	13.131	13.486
63 38840319. 1000	10.014	10.261	10.495	10.534	10.660	10.876
63 38840419. 1000	14.066	14.413	14.741	14.797	14.973	15.276
74 38840520. 1000	5.579	5.713	5.840	5.861	5.929	6.046
74 38840620. 1000	7.890	8.068	8.236	8.265	8.355	8.510

TABLE 731 MAINTENANCE/500KG M5/500KG=ME(500/W)P (2.00+,1.67-)

IDENT	P=1.0	P=.87	P=.75	P=.73	P=.67	P=.56
	MCAL	MCAL	MCAL	MCAL	MCAL	MCAL
62 38840119. 1000	8.948	9.243	9.523	9.571	9.722	9.985
62 38840219. 1000	6.343	6.552	6.751	6.785	6.892	7.078
63 38840319. 1000	4.248	4.353	4.452	4.469	4.522	4.613
63 38840419. 1000	10.337	10.592	10.833	10.874	11.003	11.226
74 38840520. 1000	-4.289	-4.392	-4.489	-4.506	-4.558	-4.648
74 38840620. 1000	-.943	-.964	-.984	-.988	-.998	-1.017

TABLE 741 CALCULATED FASTING METABOLISM (BASED ON BODY WT) FM=A(W)P

IDENT.	70W.73	72W.75	90W.75	93W.75	52W.75	73W.75
	MCAL	MCAL	MCAL	MCAL	MCAL	MCAL
62 38840119. 1000	8.103	9.177	11.344	11.472	6.564	9.317
62 38840219. 1000	8.103	9.177	11.344	11.472	6.564	9.317
63 38840319. 1000	7.745	8.763	10.832	10.954	6.268	8.897
63 38840419. 1000	7.745	8.763	10.832	10.954	6.268	8.897
74 38840520. 1000	7.716	8.729	10.790	10.912	6.244	8.863
74 38840620. 1000	7.656	8.660	10.705	10.826	6.194	8.793

TABLE 751 CALCULATED MAINTENANCE (ME OR TDN) M3=B(W)P

IDENT	141W.73	94W.75	TDN HI	TDN LO	ME
	LBS	LBS	MCAL		
62 38840119. 1000	16.206	12.050	10.575	8.705	13.863
62 38840219. 1000	16.206	12.050	10.575	8.705	13.863
63 38840319. 1000	15.490	11.506	10.108	8.320	13.237
63 38840419. 1000	15.490	11.506	10.108	8.320	13.237
74 38840520. 1000	15.432	11.462	10.070	8.289	13.186
74 38840620. 1000	15.313	11.371	9.992	8.225	13.082

TABLE 761 CALCULATED NE CONSUMED AND PLANE OF NUTRITION NE=G+FM,M3								
IDENT.		FM=70W	FM=72W	M3=141W	M3=94W	ME/ME1	ME/94W.75	
		MCAL	MCAL	MCAL	MCAL	PLANE	PLANE	
62	38840119.	1000	21.731	22.805	29.834	25.677	2.306	3.215
62	38840219.	1000	26.992	28.066	35.096	30.939	2.952	3.798
63	38840319.	1000	25.582	26.600	33.327	29.343	3.381	3.550
63	38840419.	1000	19.281	20.299	27.026	23.042	2.104	3.103
74	38840520.	1000	38.088	39.101	45.804	41.834	8.280	4.838
74	38840620.	1000	34.556	35.560	42.212	38.271	5.638	4.646

TABLE 771 TOTAL NE CONSUMED NE1,6=G+B1,6(M1)								
IDENT.		B1=0.5	B2=0.6	B3=0.7	B4=0.8	B5=0.9	B6=1.0	
		MCAL	MCAL	MCAL	MCAL	MCAL	MCAL	
62	38840119.	1000	22.025	23.789	25.384	27.064	28.743	30.423
62	38840219.	1000	26.642	28.270	29.743	31.293	32.844	34.394
63	38840319.	1000	23.877	25.145	26.293	27.501	28.709	29.918
63	38840419.	1000	20.020	21.802	23.414	25.111	26.808	28.505
74	38840520.	1000	33.720	34.423	35.059	35.729	36.399	37.068
74	38840620.	1000	31.584	32.568	33.458	34.395	35.333	36.270

TABLE 781 COMPARISON OF METHODS OF EXPRESSING ENERGY NE3=G+0.7M1								
IDENT.		DE/DM	ME/DM	NE3/DM	NE3/GE	NE3/DE	NE3/ME	
		KCAL/GM	KCAL/GM	KCAL/GM	PER CT	PER CT	PER CT	
62	38840119.	1000	3.026	2.596	1.803	41.142	59.595	69.456
62	38840219.	1000	3.003	2.609	1.781	40.570	59.316	68.285
63	38840319.	1000	3.268	2.855	1.915	43.335	58.607	67.092
63	38840419.	1000	2.989	2.566	1.786	40.410	59.750	69.599
74	38840520.	1000	3.111	2.720	1.757	39.951	56.477	64.589
74	38840620.	1000	3.053	2.680	1.740	39.587	57.015	64.953

TABLE 801 ENERGY CONTENT OF FEEDS, EXCRETA, HEAT PROD. AND PRODUCTS								
IDENT.		FEED	FECES	URINE	METHANE	MILK	HEAT,RQ	BALANCE
		MCAL	MCAL	MCAL	MCAL	MCAL	MCAL	MCAL
62	38840119.	1000	65.782	20.368	3.024	3.653	35.021	27.957
62	38840219.	1000	77.133	24.376	2.940	3.899	34.568	28.237
63	38840319.	1000	63.462	16.536	2.797	3.330	27.177	24.511
63	38840419.	1000	62.140	20.113	2.939	3.545	27.160	24.683
74	38840520.	1000	89.432	26.168	3.381	4.286	25.551	27.842
74	38840620.	1000	86.885	26.557	3.248	4.399	24.379	27.896

TABLE 802 ENERGY DISTRIBUTION (PERCENT OF GROSS ENERGY CONSUMED).								
IDENT.		GE	FECES	URINE	METHANE	MILK	HEAT,RQ	BALANCE
		MCAL	PER CT	PER CT	PER CT	PER CT	PER CT	PER CT
62	38840119.	2000	65.782	30.963	4.597	5.553	53.238	42.499
62	38840219.	2000	77.133	31.602	3.812	5.054	44.816	36.608
63	38840319.	2000	63.462	26.057	4.407	5.247	42.823	38.623
63	38840419.	2000	62.140	32.368	4.730	5.705	43.707	39.722
74	38840520.	2000	89.432	29.260	3.780	4.793	28.571	31.132
74	38840620.	2000	86.885	30.566	3.738	5.064	28.058	32.106

TABLE 811 NITROGEN CONTENT OF FEEDS EXCRETA PRODUCTS AND N BALANCE								
IDENT.		FEED	FECES	URINE	MILK	HAIR	N BAL1	N BAL2
		KG	KG	KG	KG	KG	KG	KG
62	38840119.	1000	.484	.142	.194	.177	.000	-.029
62	38840219.	1000	.566	.170	.217	.185	.000	-.007
63	38840319.	1000	.447	.116	.204	.145	.000	-.018
63	38840419.	1000	.437	.127	.204	.155	.000	-.049
74	38840520.	1000	.595	.168	.216	.191	.000	.018
74	38840620.	1000	.575	.177	.225	.188	.000	-.015

TABLE 812 NITROGEN DISTRIBUTION (PERCENT OF NITROGEN CONSUMED)
IDENT.

		FEED KG	FECES PER CT	URINE PER CT	MILK PER CT	HAIR PER CT	N BAL2 PER CT	N BAL1 PER CT
62	38840119. 2000	.484	29.434	40.059	36.579	.000	-6.074	30.505
62	38840219. 2000	.566	30.019	38.413	32.807	.095	-1.335	31.567
63	38840319. 2000	.447	25.946	45.652	32.518	.022	-4.140	28.400
63	38840419. 2000	.437	29.240	46.755	35.432	.000	-11.428	24.004
74	38840520. 2000	.595	28.314	36.366	32.232	.000	3.086	35.318
74	38840620. 2000	.575	30.826	39.126	32.793	.000	-2.746	30.046

TABLE 821 CARBON CONTENT OF FEEDS, EXCRETA, CO2+CH4, PRODUCTS AND BAL
IDENT.

		FEED KG	FECES KG	URINE KG	CO2+CH4 KG	MILK KG	HAIR KGKG	C BAL1
62	38840119. 1000	6.780	2.031	.275	3.168	2.856	.000	1.305
62	38840219. 1000	7.936	2.449	.331	3.255	3.092	.002	1.899
63	38840319. 1000	6.508	1.659	.281	2.811	2.412	.000	1.755
63	38840419. 1000	6.374	2.031	.314	2.870	2.432	.000	1.157
74	38840520. 1000	9.272	2.595	.326	3.401	2.330	.000	2.949
74	38840620. 1000	9.018	2.629	.344	3.465	2.212	.000	2.578

TABLE 822 CARBON DISTRIBUTION (PERCENT OF CARBON CONSUMED)

		FEED KG	FECES PER CT	URINE PER CT	CO2+CH4 PER CT	MILK PER CT	HAIR PER CT	C BAL1 PER CT
62	38840119. 2000	6.780	29.960	4.063	46.725	42.126	.000	19.251
62	38840219. 2000	7.936	30.863	4.176	41.027	38.964	.034	23.932
63	38840319. 2000	6.508	25.500	4.331	43.193	37.066	.007	26.974
63	38840419. 2000	6.374	31.867	4.940	45.025	38.165	.000	18.166
74	38840520. 2000	9.272	27.987	3.521	36.681	25.127	.000	31.809
74	38840620. 2000	9.018	29.155	3.822	38.430	24.532	.000	28.591

TABLE 831 NUTRIENTS METABOLIZED BASED ON RQ CALCULATIONS.

		PROT KG	CARBOH. KG	FAT KG	PROT MCAL	CARBOH. MCAL	FAT MCAL
62	38840119. 1000	1.213	5.696	.872	5.337	23.927	8.284
62	38840219. 1000	1.360	6.101	.752	5.985	25.627	7.144
63	38840319. 1000	1.272	5.180	.700	5.599	21.756	6.658
63	38840419. 1000	1.275	5.439	.627	5.610	22.845	5.958
74	38840520. 1000	1.352	7.486	.137	5.952	31.445	1.304
74	38840620. 1000	1.408	7.959	-.052	6.195	33.428	-.500

TABLE 832 TOTAL HEAT PRODUCTION (RQ) H1=3.8660+1.200C-0.229P-0.518M
IDENT

		H1 MCAL	H2 MCAL	H3 MCAL	H4(L24) MCAL	H5(L12) MCAL	RQ2	RQ3
62	38840119. 2000	27.957	27.825	28.105	25.831	27.446	.920	.800
62	38840219. 2000	28.237	28.107	28.394	25.630	27.232	.932	.806
63	38840319. 2000	24.511	24.397	24.648	22.318	23.713	.927	.803
63	38840419. 2000	24.683	24.569	24.823	22.535	23.944	.936	.805
74	38840520. 2000	27.842	27.724	28.011	26.027	27.653	.987	.853
74	38840620. 2000	27.896	27.782	28.072	25.955	27.577	1.004	.870

TABLE 833 HEAT PRODUCTION PER UNIT METABOLIC BODY WT. (KCAL/W.75)

		H1/W.75 KCAL/WP	H2/W.75 KCAL/WP	H3/W.75 KCAL/WP	H4/W.75 KCAL/WP	H5/W.75 KCAL/WP	H6/W.75 KCAL/WP	H7/W.75 KCAL/WP
62	38840119. 3000	219.330	218.295	220.488	202.654	215.320	176.353	197.842
62	38840219. 3000	221.531	220.504	222.756	201.079	213.647	202.962	212.246
63	38840319. 3000	201.383	200.443	202.509	183.363	194.823	177.046	189.215
63	38840419. 3000	202.798	201.862	203.946	185.150	196.722	194.727	198.763
74	38840520. 3000	229.634	228.666	231.032	214.663	228.080	185.312	207.473
74	38840620. 3000	231.177	230.234	232.636	215.095	228.538	197.070	214.123

TABLE 834 HEAT PRODUCTION PER UNIT INTAKE.

IDENT		H1/DM KCAL/GM	H1/GE PER CT	H1/DE PER CT	H1/ME3 PER CT	H1/AE PER CT
62	38840119.	4000	186.318	42.499	61.561	71.768
62	38840219.	4000	160.778	36.608	53.523	61.426
63	38840319.	4000	170.745	38.623	52.234	59.878
63	38840419.	4000	175.577	39.722	58.733	68.729
74	38840520.	4000	136.950	31.132	44.009	50.203
74	38840620.	4000	141.188	32.106	46.240	52.836
						56.610

TABLE 841 SUMMARY OF ENERGY CONSUMED (DE,ME2,ME3) AND ENERGY BALANCE

IDENT		DE MCAL	ME2 MCAL	ME3 MCAL	G2(RQ) MCAL	G3(RQ) MCAL	G4(CN) MCAL	G1(AVE) MCAL
62	38840119.	1000	45.413	38.735	38.955	10.778	10.997	16.475
62	38840219.	1000	52.757	45.917	45.969	17.679	17.731	20.098
63	38840319.	1000	46.925	40.798	40.935	16.286	16.423	19.385
63	38840419.	1000	42.027	35.541	35.914	10.858	11.230	12.213
74	38840520.	1000	63.263	55.595	55.459	27.753	27.616	32.990
74	38840620.	1000	60.327	52.679	52.797	24.783	24.901	29.016
								26.899

TABLE 842 METABOLIZABLE AND AVAILABLE ENERGY, W.75, HEAT PROD(CN)

IDENT		ME2 PER CT	ME3 PER CT	AE CONS MCAL	AE/DM KCAL/GM	AE PER CT	W.75/10 KG	H6(CN) MCAL
62	38840119.	2000	58.885	59.218	36.032	2.401	54.775	12.746
62	38840219.	2000	59.529	59.597	42.850	2.439	55.553	12.746
63	38840319.	2000	64.286	64.503	38.271	2.665	60.305	12.171
63	38840419.	2000	57.195	57.795	33.077	2.352	53.230	12.171
74	38840520.	2000	62.165	62.012	52.029	2.559	58.177	12.124
74	38840620.	2000	60.630	60.766	49.277	2.494	56.715	12.066
								23.780

TABLE 843 INTAKE PER UNIT METABOLIC BODY WT. (KCAL/W.75)

IDENT		DM GM/WP	GE KCAL/WP	DE KCAL/WP	ME3 KCAL/WP	AE KCAL/WP	G3(RQ) KCAL/WP	G4(CN) KCAL/WP
62	38840119.	3000	117.717	516.071	356.275	305.609	282.680	86.279
62	38840219.	3000	137.786	605.128	413.891	360.641	336.170	139.110
63	38840319.	3000	117.943	521.400	385.535	336.319	314.431	134.936
63	38840419.	3000	115.503	510.541	345.289	295.068	271.763	92.269
74	38840520.	3000	167.677	737.610	521.780	457.409	429.126	227.774
74	38840620.	3000	163.736	720.026	499.941	437.533	408.363	206.356
								240.463

TABLE 851 NITROGEN BALANCE SUMMARY (NB1 = FEED N - (FECES+URINE N)

IDENT		N BAL1 KG	-MILK KG	-HAIR KG	TISSUE KG	TISSUE MCAL
62	38840119.	1000	.147	-.029	-.029	-.183
62	38840219.	1000	.178	-.007	-.007	-.047
63	38840319.	1000	.126	-.018	-.018	-.115
63	38840419.	1000	.105	-.049	-.049	-.312
74	38840520.	1000	.210	.018	.018	.114
74	38840620.	1000	.173	-.015	-.015	-.098
						-.434

TABLE 861 CARBON BALANCE SUMMARY (CB1 = FEED C - (FECES+URINE+GAS C)

IDENT		C BAL1 KG	-MILK KG	-HAIR KG	PROT C KG	FAT C KG	FAT DEP KG	FAT MCAL
62	38840119.	1000	1.305	-1.551	-1.551	-.094	-1.456	-1.893
62	38840219.	1000	1.899	-1.192	-1.195	-.024	-1.171	-1.522
63	38840319.	1000	1.755	-.656	-.657	-.059	-.598	-.777
63	38840419.	1000	1.157	-1.274	-1.274	-.159	-1.114	-1.448
74	38840520.	1000	2.949	.619	.619	.058	.560	.728
74	38840620.	1000	2.578	.366	.366	-.050	.416	.541
								5.072

TABLE 901 FEED OFFERED/24 HR (QUANTITIES)

IDENT		DRY M.	ENERGY	NITROGEN	CARBON	ORG M.	C PROT
		KG	MCAL	KG	KG	KG	KG
62	38840119.	1504	12.075	52.785	.390	5.477	10.824
62	38840119.	1564	7.724	34.340	.248	3.480	7.391
62	38840219.	1504	12.075	52.785	.390	5.477	10.824
62	38840219.	1564	7.724	34.340	.248	3.480	7.391
63	38840319.	1504	8.722	38.431	.266	3.968	7.796
63	38840319.	1564	5.633	25.031	.180	2.540	5.385
63	38840419.	1504	8.722	38.431	.266	3.968	7.796
63	38840419.	1564	5.633	25.031	.180	2.540	5.385
74	38840520.	1504	8.355	36.744	.222	3.816	7.667
74	38840520.	1564	12.255	53.943	.381	5.582	11.733
74	38840620.	1504	8.355	36.744	.222	3.816	7.667
74	38840620.	1564	12.255	53.943	.381	5.582	11.733

TABLE 902 FEED OFFERED/24 HR (QUANTITIES)

IDENT		EE	C FIBER	NFE	ADF	CHO	ASH
IDENT		KG	KG	KG	KG	KG	KG
62	38840119.	2504	.243	3.089	5.052	3.545	7.472
62	38840119.	2564	.298	.584	4.953	.412	5.479
62	38840219.	2504	.243	3.089	5.052	3.545	7.472
62	38840219.	2564	.298	.584	4.953	.412	5.479
63	38840319.	2504	.217	2.239	3.675	2.571	5.444
63	38840319.	2564	.129	.425	3.701	.299	4.084
63	38840419.	2504	.217	2.239	3.675	2.571	5.444
63	38840419.	2564	.129	.425	3.701	.299	4.084
74	38840520.	2504	.144	2.744	3.388	3.262	5.503
74	38840520.	2564	.264	.885	8.197	.599	9.018
74	38840620.	2504	.144	2.744	3.388	3.262	5.503
74	38840620.	2564	.264	.885	8.197	.599	9.018

TABLE 903 FEED OFFERED/24 HR (QUANTITIES) AND DERIVED VALUES

IDENT		LIGNIN	CR203	NDF	CR PROT	ORG M	NFE
IDENT		KG	KG	KG	PER CT	PER CT	PER CT
62	38840119.	3504	.669	.000	.476	20.200	89.640
62	38840119.	3564	.058	.000	.084	20.143	95.700
62	38840219.	3504	.669	.000	.476	20.200	89.640
62	38840219.	3564	.058	.000	.084	20.143	95.700
63	38840319.	3504	.470	.000	.334	19.087	89.390
63	38840319.	3564	.042	.000	.061	20.056	95.610
63	38840419.	3504	.470	.000	.334	19.087	89.390
63	38840419.	3564	.042	.000	.061	20.056	95.610
74	38840520.	3504	.629	.000	.422	16.631	91.760
74	38840520.	3564	.064	.000	.134	19.462	95.740
74	38840620.	3504	.629	.000	.422	16.631	91.760
74	38840620.	3564	.064	.000	.134	19.462	95.740

TABLE 911 FEED REFUSED/24 HR (QUANTITIES)

IDENT		DRY M.	ENERGY	NITROGEN	CARBON	ORG M.	C PROT
		KG	MCAL	KG	KG	KG	KG
62	38840119.	1604	1.947	8.678	.064	.878	1.805
62	38840119.	1614	2.846	12.665	.090	1.299	2.707
62	38840219.	1604	2.236	9.991	.072	1.022	2.119
63	38840419.	1614	.296	1.321	.009	.134	.282
74	38840520.	1604	.280	1.255	.008	.125	.264
74	38840620.	1604	.249	1.112	.008	.111	.231
74	38840620.	1614	.603	2.690	.019	.269	.560

TABLE 912		FEED REFUSED/24 HR		(QUANTITIES)			
IDENT		EE	C FIBER	NFE	ADF	CHO	ASH
IDENT		KG	KG	KG	KG	KG	KG
62	38840119. 2604	.051	.326	1.025	.342	1.288	.142
62	38840119. 2614	.068	.259	1.814	.211	2.041	.139
62	38840219. 2604	.057	.240	1.367	.214	1.567	.117
63	38840419. 2614	.007	.026	.188	.020	.211	.014
74	38840520. 2604	.008	.033	.166	.031	.194	.016
74	38840620. 2604	.007	.026	.146	.023	.168	.017
74	38840620. 2614	.017	.063	.354	.055	.407	.042

TABLE 913		FEED REFUSED/24 HR		(QUANTITIES)				AND DERIVED VALUES
IDENT		LIGNIN	CR203	NDF	CR PROT	ORG M	NFE	
IDENT		KG	KG	KG	PER CT	PER CT	PER CT	
62	38840119. 3604	.062	.000	.049	20.668	92.690	52.646	
62	38840119. 3614	.033	.000	.038	19.818	95.090	63.728	
62	38840219. 3604	.040	.000	.035	20.287	94.760	61.150	
63	38840419. 3614	.003	.000	.003	20.300	95.280	63.520	
74	38840520. 3604	.006	.000	.005	19.556	94.000	59.398	
74	38840620. 3604	.004	.000	.004	20.656	92.930	58.806	
74	38840620. 3614	.010	.000	.009	20.656	92.930	58.806	

TABLE 921		NET CONSUMED/24 HR		(QUANTITIES)			
IDENT		DRY M.	ENERGY	NITROGEN	CARBON	ORG M.	C PROT
IDENT		KG	MCAL	KG	KG	KG	KG
62	38840119. 1614	15.005	65.782	.484	6.780	13.704	3.028
62	38840219. 1604	17.563	77.133	.566	7.936	16.097	3.541
63	38840319. 1564	14.355	63.462	.447	6.508	13.182	2.794
63	38840419. 1614	14.058	62.140	.437	6.374	12.899	2.734
74	38840520. 1604	20.330	89.432	.595	9.272	19.136	3.719
74	38840620. 1614	19.758	86.885	.575	9.018	18.607	3.598

TABLE 922		NET CONSUMED/24 HR		(QUANTITIES)			
IDENT		EE	C FIBER	NFE	ADF	CHO	ASH
IDENT		KG	KG	KG	KG	KG	KG
62	38840119. 2614	.422	3.087	7.166	3.403	9.621	1.301
62	38840219. 2604	.484	3.432	8.638	3.743	11.383	1.465
63	38840319. 2564	.346	2.664	7.377	2.871	9.528	1.172
63	38840419. 2614	.338	2.638	7.188	2.850	9.317	1.158
74	38840520. 2604	.400	3.596	11.419	3.829	14.327	1.193
74	38840620. 2614	.383	3.540	11.084	3.782	13.946	1.150

TABLE 923		NET CONSUMED/24 HR		(QUANTITIES)	
IDENT		LIGNIN	CR203	NDF	
IDENT		KG	KG	KG	
62	38840119. 3614	.631	.000	.473	
62	38840219. 3604	.687	.000	.525	
63	38840319. 3564	.512	.000	.396	
63	38840419. 3614	.509	.000	.392	
74	38840520. 3604	.687	.000	.552	
74	38840620. 3614	.678	.000	.543	

TABLE 931		FECES EXCRETED/24 HR		(QUANTITIES)			
IDENT		DRY M.	ENERGY	NITROGEN	CARBON	ORG M.	C PROT
IDENT		KG	MCAL	KG	KG	KG	KG
62	38840119. 1626	4.353	20.368	.142	2.031	3.886	.891
62	38840219. 1626	5.186	24.376	.170	2.449	4.637	1.063
63	38840319. 1626	3.495	16.536	.116	1.659	3.092	.725
63	38840419. 1626	4.248	20.113	.127	2.031	3.765	.799
74	38840520. 1626	5.406	26.168	.168	2.595	4.995	1.053
74	38840620. 1626	5.522	26.557	.177	2.629	5.074	1.109

TABLE 932 FECEX EXCRETED/24 HR (QUANTITIES)							
IDENT	EE	C FIBER	NFE	ADF	CHO	ASH	
IDENT	KG	KG	KG	KG	KG	KG	
62 38840119. 2626	.154	1.414	1.425	1.679	2.279	.467	
62 38840219. 2626	.189	1.615	1.769	1.907	2.780	.548	
63 38840319. 2626	.139	1.032	1.196	1.210	1.827	.403	
63 38840419. 2626	.141	1.399	1.425	1.664	2.277	.483	
74 38840520. 2626	.178	1.605	2.158	1.883	3.219	.410	
74 38840620. 2626	.177	1.572	2.215	1.834	3.262	.447	

TABLE 933 FECEX EXCRETED/24 HR (QUANTITIES) AND DERIVED VALUES							
IDENT	LIGNIN	CR203	NDF	CR PROT	ORG M	NFE	
IDENT	KG	KG	KG	PER CT	PER CT	PER CT	
62 38840119. 3626	.561	.000	.221	20.475	89.260	32.750	
62 38840219. 3626	.605	.000	.264	20.500	89.430	34.127	
63 38840319. 3626	.401	.000	.163	20.743	88.470	34.221	
63 38840419. 3626	.547	.000	.224	18.818	88.630	33.546	
74 38840520. 3626	.543	.000	.293	19.481	92.400	39.918	
74 38840620. 3626	.525	.000	.275	20.087	91.890	40.117	

TABLE 941 DIGESTED NUTRIENTS/24 HR (QUANTITIES)							
IDENT	DIG DM	DIG CAL	DIG N	DIG C	DIG DM	DIG PROT	
IDENT	KG	MCAL	KG	KG	KG	KG	
62 38840119. 1626	10.651	45.413	.341	4.748	9.818	2.137	
62 38840219. 1626	12.377	52.757	.396	5.486	11.459	2.478	
63 38840319. 1626	10.859	46.925	.331	4.848	10.090	2.069	
63 38840419. 1626	9.809	42.027	.309	4.342	9.134	1.934	
74 38840520. 1626	14.923	63.263	.426	6.677	14.140	2.666	
74 38840620. 1626	14.235	60.327	.398	6.388	13.533	2.489	

TABLE 942 DIGESTED NUTRIENTS/24 HR (QUANTITIES)							
IDENT	DIG EE	DIG CF	DIG NFE	DIG ADF	DIG CHO	DIG ASH	
IDENT	KG	KG	KG	KG	KG	KG	
62 38840119. 2626	.268	1.672	5.740	1.724	7.342	.833	
62 38840219. 2626	.295	1.817	6.868	1.835	8.603	.917	
63 38840319. 2626	.207	1.632	6.181	1.660	7.701	.769	
63 38840419. 2626	.197	1.238	5.763	1.185	7.040	.675	
74 38840520. 2626	.221	1.990	9.261	1.946	11.108	.782	
74 38840620. 2626	.206	1.967	8.869	1.947	10.684	.702	

TABLE 943 DIGESTED NUTRIENTS/24HR (QUANTITIES)			
IDENT	LIGNIN	CR203	NDF
IDENT	KG	KG	KG
62 38840119. 3626	.070	.000	.251
62 38840219. 3626	.082	.000	.261
63 38840319. 3626	.111	.000	.233
63 38840419. 3626	-.038	.000	.168
74 38840520. 3626	.144	.000	.259
74 38840620. 3626	.153	.000	.268

TABLE 951 DIGESTION COEFFICIENTS CALCULATED FROM LIGNIN RATIO								
IDENT	DIG DM	DIG CAL	DIG N	DIG C	DIG OM	TDN	ENE	
	PER CT	PER CT	PER CT	PER CT	PER CT	PER CT	MCAL/CWT	
62 38840119. 1626	67.33	65.14	66.86	66.27	68.07	64.24	54.86	
62 38840219. 1626	66.47	64.11	65.91	64.95	67.28	63.58	53.94	
63 38840319. 1626	68.87	66.69	66.83	67.40	70.01	65.76	56.97	
63 38840419. 1626	71.89	69.90	72.80	70.36	72.85	68.69	61.05	
74 38840520. 1626	66.36	62.98	64.18	64.59	66.97	64.11	54.68	
74 38840620. 1626	63.91	60.53	60.20	62.35	64.78	61.99	51.73	

TABLE 952 DIGESTION COEFFICIENTS CALCULATED FROM LIGNIN RATIO								
IDENT	DIG EE	DIG CF	DIG NFE	DIG ADF	DIG CHO	DIG ASH		
IDENT	PER CT	PER CT	PER CT	PER CT	PER CT	PER CT		
62 38840119.	2626 58.90	48.41	77.60	44.45	73.33	59.54		
62 38840219.	2626 55.64	46.55	76.73	42.12	72.26	57.54		
63 38840319.	2626 48.63	50.48	79.27	46.12	75.49	56.07		
63 38840419.	2626 61.23	50.66	81.56	45.68	77.27	61.23		
74 38840520.	2626 43.50	43.53	76.09	37.78	71.57	56.46		
74 38840620.	2626 40.38	42.65	74.19	37.37	69.79	49.72		

TABLE 953 DIGESTION COEFFICIENTS CALCULATED FROM LIGNIN RATIO						
IDENT	LIGNIN	CR203	NDF	TDN CONS	ENE CONS	
IDENT	PER CT	PER CT	PER CT	KG	MCAL	
62 38840119.	3626 .00	100.00	47.28	9.64	18.13	
62 38840219.	3626 .00	100.00	42.95	11.16	20.86	
63 38840319.	3626 .00	100.00	47.33	9.44	18.01	
63 38840419.	3626 .00	100.00	46.82	9.65	18.90	
74 38840520.	3626 .00	100.00	32.81	13.03	24.48	
74 38840620.	3626 .00	100.00	34.66	12.24	22.51	

TABLE 961 DIGESTION COEFFICIENTS CALCULATED FROM CR(2)O(3) RATIO							
IDENT	DIG DM	DIG CAL	DIG N	DIG C	DIG OM	TDN	ENE
	PER CT	PER CT	PER CT	PER CT	PER CT	PER CT	MCAL/CWT

TABLE 962 DIGESTION COEFFICIENTS CALCULATED FROM CR(2)O(3) RATIO							
IDENT	DIG EE	DIG CF	DIG NFE	DIG ADF	DIG CHO	DIG ASH	
IDENT	PER CT	PER CT	PER CT	PER CT	PER CT	PER CT	

TABLE 963 DIGESTION COEFFICIENTS CALCULATED FROM CR(2)O(3) RATIO						
IDENT	LIGNIN	CR203	NDF	TDN CONS	ENE CONS	
IDENT	PER CT	PER CT	PER CT	KG	MCAL	

TABLE 971 DIGESTION COEFFICIENTS CALCULATED FROM TOTAL COLLECTION								
IDENT	DIG DM	DIG CAL	DIG N	DIG C	DIG OM	TDN	ENE	
	PER CT	PER CT	PER CT	PER CT	PER CT	PER CT	PER CT	MCAL/CWT
62 38840119.	1626 70.98	69.03	70.56	70.03	71.64	67.66	59.62	
62 38840219.	1626 70.47	68.39	69.98	69.13	71.18	67.34	59.18	
63 38840319.	1626 75.64	73.94	74.05	74.49	76.54	72.09	65.79	
63 38840419.	1626 69.77	67.63	70.75	68.13	70.80	66.72	58.32	
74 38840520.	1626 73.40	70.73	71.68	72.01	73.89	70.91	64.15	
74 38840620.	1626 72.04	69.43	69.17	70.84	72.72	69.80	62.60	

TABLE 972 DIGESTION COEFFICIENTS CALCULATED FROM TOTAL COLLECTION							
IDENT	DIG EE	DIG CF	DIG NFE	DIG ADF	DIG CHO	DIG ASH	
IDENT	PER CT	PER CT	PER CT	PER CT	PER CT	PER CT	
62 38840119.	2626 63.49	54.17	80.10	50.65	76.31	64.06	
62 38840219.	2626 60.93	52.93	79.51	49.03	75.57	62.60	
63 38840319.	2626 59.81	61.26	83.78	57.84	80.82	65.63	
63 38840419.	2626 58.31	46.94	80.17	41.59	75.55	58.30	
74 38840520.	2626 55.33	55.36	81.10	50.81	77.52	65.57	
74 38840620.	2626 53.82	55.58	80.01	51.49	76.60	61.06	

TABLE 973 DIGESTION COEFFICIENTS CALCULATED FROM TOTAL COLLECTION						
IDENT	LIGNIN	CR203	NDF	TDN CONS	ENE CONS	
IDENT	PER CT	PER CT	PER CT	KG	MCAL	
62 38840119.	3626 11.17	100.00	53.17	10.15	19.70	
62 38840219.	3626 11.93	100.00	49.76	11.82	22.89	
63 38840319.	3626 21.76	100.00	58.79	10.34	20.80	
63 38840419.	3626 -7.53	100.00	42.81	9.38	18.05	
74 38840520.	3626 20.94	100.00	46.88	14.41	28.73	
74 38840620.	3626 22.54	100.00	49.39	13.79	27.24	